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## **A methodology for uncertainty analysis of reference equations of state**

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We present a detailed methodology for the uncertainty analysis of reference equations of state (EOS) based on Helmholtz energy. In recent years there has been an increased interest in uncertainties of property data and process models of thermal systems. In the literature there are various methodologies to assess uncertainty of measured property data. Currently there is still a lack of methodologies to quantify property uncertainties from property models, such as EOS. EOS developers and users either do not report uncertainties or report underestimated values. In this work linear approximation for uncertainty analysis is suggested as a tool for EOS. The uncertainties of the EOS properties are calculated from the experimental values and the EOS model structure through the parameter covariance matrix and subsequent linear error propagation. This allows reporting the uncertainty range (95% confidence interval) of every EOS property value. As an example the Helmholtz-based EOS of propane is thoroughly analysed with respect to its uncertainty. The results show, in which temperature and pressure ranges, high and low property uncertainties occur. The uncertainty methodology is generic and can be applied for any novel EOS. Furthermore, the methodology is suitable for already existing EOS, since re-training of the data is not necessary. The study clearly demonstrates that a thorough uncertainty analysis gives valuable insights for EOS users and developers.